

# **BENEFITS OF ADOPTING GREEN CONCEPT FOR CONSTRUCTION OF BUILDINGS IN SRI LANKA**

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## **Abstract**

While moving towards the sustainable development, the concept of green building has become the forefront in the construction industry globally. Simply, green buildings increase the efficiency of resources while sustaining natural resources for the future generation and reduce impact on human and environment. With the global interest, nowadays construction of green buildings has become a new trend in Sri Lanka as well. Many studies identified that there is a significant initial investment perceived in the green construction than conventional buildings. However, it is important for a developing country like Sri Lanka to identify the real benefits and challenges when adopting green concept in construction of buildings. Thus, the research aimed at investigating the benefits associated with green buildings for a country like Sri Lanka and analysed each benefit in terms of achievable time duration.

The questionnaire survey was used as a main data collection method and statistic technique, relative importance index was used to analyse the data. Findings obtained from Thirty-four key professionals were used to derive the conclusions. The results indicated that the construction of a green building provides many environmental, economic and social benefits to the owners and users of the built-environment. Furthermore, the paper discussed the level of importance of individual factors under main three categories. In addition, it is evident that most of benefits are achievable in long-run where approximately it takes more than two years to achieve after construction of a green building.

**Keywords:** Benefits, Construction industry, Green buildings, Sustainability

# 1. Introduction

Construction is a major industry throughout the world that has a significant impact on the environment, economic and social development (Chan *et al.*, 2009). The need for greater environmental consideration in the context of sustainable development has been accepted by many governments, businesses, organisations and individuals (Ofori *et al.*, 2000). According to Ortiz *et al.* (2007), the term sustainable development can be described as enhancing quality of life and allowing people to live in a healthy environment and improve social, economic and environmental conditions for present and future generations. Abidin (2010) stated that sustainable construction is perceived as a way for the construction industry to contribute to the effort to reach sustainable development. Green building is a part of the concept of promoting sustainability (Chan *et al.*, 2009). According to Kats *et al.* (2003), green buildings use key resources like energy, material, water and land more efficiently than conventional buildings and it will contribute to the improvement in employee health, comfort and productivity. Moreover, as per Kats *et al.* (2003), it is evident that green buildings have an impact on the financial benefits of the building in long-run.

As global interest on sustainability has grown steadily (Abidin, 2010), the concept of green building construction has recently come to the forefront of the construction industry in Sri Lanka. Nowadays most of the building constructions are done according to the green concept and many Sri Lankan green buildings have achieved the certification of awards according to the Environmental Classification Systems for green buildings. There are many challenges for a developing country like Sri Lanka when leading towards the sustainable construction. Moreover, Holcim Foundation for Sustainable Construction (2009) pinpointed that, the initial cost of construction of green factory building in Thulhiriya, Sri Lanka was 30% higher than the construction of a conventional factory building in Sri Lanka. In order to that, questions arise whether is it worth while to spend higher amount of money for the construction of green buildings and what are the real benefits of adopting green concept to a developing country like Sri Lanka.

Therefore, this study aimed at investigating the benefits associated in terms of economic, social and environmental aspects by adopting a green concept in Sri Lanka. In pursuit of the above aim, the objectives of the study were formed as; to identify the concept of green buildings and the costs and benefits associated with green construction, to identify the green building approaches in Sri Lankan construction industry and to discover the most beneficial components in terms of economical, environmental and social aspects together with the period of achievement of each benefit while constructing green buildings in Sri Lanka.

## 2. The concept of Green buildings

There is a concern about how to improve construction practices in order to minimise their negative impacts on the natural environment (Holmes and Hudson, 2000; Cole, 2005; Pahwa, 2007). When consider about Asian countries, according to Chan *et al.* (2009), in Hong Kong, buildings consume overall half of all energy and about 89% of electricity, mainly and substantially for air conditioning

which is the cause of roughly 17% of all green house gas emissions in the country. As the environmental impacts of building activities become more apparent, a movement called “Green building” is gaining momentum under the concept of sustainable construction. Kibert (2007, p.9) has defined green buildings as “Healthy facilities designed and built in a resource efficient manner, using ecologically based principles”. Further, as per Woolley *et al.* (1997), a green building is not simply about protecting the environment and natural resources from over-exploitation or over-consumption, it is simply about saving energy, but it considers the impact of buildings and materials on occupants and the impact of our lives on the future of the Earth. Green building has now become a flagship of sustainable development in this century that takes the responsibility for balancing long-term economic, environmental and social health (Ali and Nsairat, 2008). As a result of that, the concept of green buildings has won the acceptance of the construction industry and it continues to impact building design, construction and operation. Even though, the green building concept emerged during the late nineteenth and early twentieth centuries (Cassidy, 2003), it is until recently that green building has stepped into a flourishing development.

Cole (2000) stated that the intent of green building is relatively straightforward which reduce the resource use and environmental impact significantly beyond typical practice while offering appropriate indoor environmental quality. The supposition is that by continually improving the environmental performance of individual buildings, the collective reduction in resource use and ecological loadings by the building sector will be sufficient to address the environmental sustainability agenda (Cole, 1999 cited Cole, 2000 p.305). In these terms, further Cole (2000) described that a green building is the one that offers the highest environmental performance within the site, programme, regulatory and cost constraints. By considering ideas and information collected through many research papers and books, it is evident that the green buildings are buildings which use resources efficiently than the conventional buildings and it provides its total contribution towards the sustainable development by providing healthy and productive environments for occupants.

## **2.1 Costs and benefits of green buildings**

“Assessing the costs and benefits of any building - let alone a green one – can be elusive” (Bordass, 2000, p.338). Thus, the consideration of costs and benefits of green buildings is utmost important. There is a widespread belief that green buildings cost much more to build than traditional buildings (Cole, 2000; Kats, 2003; Morris, 2007; Jayalath, 2010). Moreover, Jayalath (2010) depicted that there is 20 - 25% increase in construction costs of green buildings in Sri Lanka and as an evident which substantiate the statement, the initial cost of construction of green factory building in Thulhiriya Sri Lanka is 30% higher than the construction of conventional factory building (Holcim Foundation for Sustainable Construction, 2009). But Morris (2007) identified that the cost for incorporating sustainable design elements highly depend on a wide range of factors such as building type, project location, local climate, site conditions, and the familiarity of the project team with sustainable design.

Even though, the initial costs associated with green buildings are perceived to be higher (Lavy and Fernández-Solís, 2009), many studies have emphasized the benefits of green buildings (Deni Greene Consultancy Services, 1999; Cassidy, 2003; Kats, 2003; Hodges, 2005). The Leadership in Energy

and Environmental Design (LEED) is identified six key fundamental principles under features of sustainability/green construction such as sustainable site, water efficiency, energy efficiency, material and resources, indoor environmental quality and commissioning, operation and maintenance. Table 1 shows the benefits of sustainable design in terms of economic, societal and environmental under each principle. Further, same format could be seen in the GreenSL also since Sri Lankan Green rating system is developed according to the LEED.

*Table 1: Benefits of sustainable design*

<b>Key principles</b>	<b>Economic</b>	<b>Societal</b>	<b>Environmental</b>
<b>Sustainable Sites</b>	<ul style="list-style-type: none"> <li>• Reduced costs for site preparation, parking lots and roads</li> <li>• Lower energy costs due to optimal orientation</li> <li>• Less landscape maintenance cost</li> </ul>	<ul style="list-style-type: none"> <li>• Improved aesthetics (e.g., better appearance of site to neighbors)</li> <li>• Increased transportation options for employees</li> </ul>	<ul style="list-style-type: none"> <li>• Land preservation</li> <li>• Lower resource use</li> <li>• Protection of ecological resources</li> <li>• Soil and water conservation</li> <li>• Reduced energy use and air pollution</li> </ul>
<b>Water Efficiency</b>	<ul style="list-style-type: none"> <li>• Lower first costs</li> <li>• Reduced annual water costs and wastewater costs</li> </ul>	<ul style="list-style-type: none"> <li>• Preservation of water resources for future generations and for recreational and agricultural uses.</li> <li>• Fewer waste water treatment plants</li> </ul>	<ul style="list-style-type: none"> <li>• Lower potable water use and pollution discharges to waterways</li> <li>• Less strain on aquatic ecosystems in water-scarce areas</li> <li>• Preservation of water resources for wildlife and agriculture</li> </ul>
<b>Energy Efficiency</b>	<ul style="list-style-type: none"> <li>• Lower first costs, when systems can be downsized due to integrated energy solutions</li> <li>• Lower annual fuel and electricity costs due to the reduced peak power demand</li> <li>• Reduced demand for new energy infrastructure, lowering energy costs to consumers</li> </ul>	<ul style="list-style-type: none"> <li>• Improved thermal conditions; better occupant comfort satisfaction</li> <li>• Fewer new power plants and transmission lines</li> </ul>	<ul style="list-style-type: none"> <li>• Lower electricity and fossil fuel use</li> <li>• Less air pollution and carbon dioxide emissions</li> <li>• Decreased impact of fossil fuel production and distribution</li> </ul>
<b>Materials and Resources</b>	<ul style="list-style-type: none"> <li>• Decreased first costs due to material re-use and use of recycled materials</li> <li>• Lower costs for waste disposal</li> <li>• Decreased replacement cost for more durable materials</li> <li>• Lower costs for new landfills</li> </ul>	<ul style="list-style-type: none"> <li>• Fewer landfills and associated nuisances</li> <li>• Expanded market for environmentally preferable products</li> <li>• Decreased traffic due to use of local/regional materials</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced strain on landfills. Reduced virgin resource use</li> <li>• Healthier forests due to better management</li> <li>• Lower energy use for material transportation</li> <li>• Lower energy and pollution</li> <li>• Increase in local recycling market</li> </ul>

<b>Indoor Environmental Quality</b>	<ul style="list-style-type: none"> <li>• Organizational productivity improvements due to improved worker performance, lower absenteeism, and reduced staff turnover</li> <li>• Lower disability/ health insurance costs.</li> <li>• Reduced threat of litigation</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced adverse health impacts</li> <li>• Improved occupant satisfaction and comfort.</li> <li>• Better individual productivity</li> </ul>	<ul style="list-style-type: none"> <li>• Better air quality inside the facility, including reduced volatile organic emissions, carbon dioxide and carbon monoxide</li> </ul>
<b>Commissioning, Operation and Maintenance</b>	<ul style="list-style-type: none"> <li>• Energy cost reduction</li> <li>• Reduced cost of dealing with complaints of occupant/owner</li> <li>• Longer building and equipment lifetimes</li> </ul>	<ul style="list-style-type: none"> <li>• Improve occupant productivity, satisfaction, health, and safety</li> </ul>	<ul style="list-style-type: none"> <li>• Lower energy consumption, as well as air pollution and carbon dioxide emissions and other environmental impacts of energy production and use</li> </ul>

(Source: FEMP, 2003; Kats, 2003; Ries et al., 2006; Chan et al., 2009)

## 2.2 Green building approaches in Sri Lanka

As the green building concept is quite new to the current Sri Lankan context, it is rapidly expanding all over different industries while searching for more energy efficient buildings for their usage (GBCSL, 2010) and now Sri Lanka has initiated to transform the construction industry with green building practices. Thus, Green Building Council of Sri Lanka came into existence as a result of an emerging trend towards applying the greener concepts for built environment (GBCSL, 2010). Considering the present and emerging challenges in the path of sustainable development, the government of Sri Lanka developed a national program named 'Haritha (Green) Lanka' to achieve the sustainable development in the country. One of the most recent and innovative example is MAS Thurulie factory at Thulhiriya which became the winner of Globe Award for Sustainability Innovation 2010 (MAS Holdings Ltd, 2010). Further, it is being awarded the LEED Platinum certification by the United States Green Building Council, making it the World's first LEED Platinum newly built factory. Apart from that there are handfuls of buildings which have been considered as green buildings in Sri Lanka. In 2010, a new Construction rating system called GREENSL® rating system which is very much similar to the LEED has been introduced by the Green building council to issue the green certification.

## 3. Research Methodology

In order to accomplish the research objectives, quantitative research approach was followed which was identified as the most appropriate method for gathering and analysing data. The data collection process was done through a questionnaire survey. Professionals' perceptions on the level of benefit and the period of achievement of each benefit identified through the literature review were retested through questionnaire findings. Before distributing the questionnaires, a pilot survey was conducted with two experts in the industry who possesses grater knowledge and experience in the green building

construction. Then, thirty six professionals who work and have experience in green building projects in Sri Lanka were selected.

The level of benefit was analysed using Relative Importance Index and the period of achievement was analysed using the Mode. The level of benefit was evaluated with five point Likert scale ranged from ‘not at all’ (1) to ‘very high’ (5). The period of achievement was evaluated using the scale given in Table 2.

*Table 2: Scale for period of achievement*

Level of achievement		
1- No idea	2- Short term	3- Long term

Where : No idea - Respondents do not have an idea about the period of achievement

Short term - Time period less than two years after construction

Long term - Time period more than two years after construction

## 4. Research findings and data analysis

This section illustrates the findings of this research study together with the analysis and interpretation of these findings. The sample consisted with five architects, fifteen engineers, eight energy management specialist and six quantity surveyors. Out of the thirty six individuals, only thirty four responded to the questionnaire with the 94 % response rate. The respondents’ experience was judged based on the number of projects they had involved. Majority of them had handled to 2-10 projects and it was 56% from the total sample. Furthermore, categories of less than two projects and more than ten projects include 29% and 15% respectively out of the selected sample.

### 4.1 Analysis on Economic benefits

Level of economic benefits were analysed using RII and results were given in Figure 1. It is apparent that most of the respondents believe ‘lower energy cost’ (RII- 90.30%) is the most beneficial economical component in adopting green concept for construction of buildings in Sri Lanka. Lower annual electricity cost, reduce annual water cost and wastewater cost, lower annual fuel cost and lower cost for waste disposal were identified as the next top four economic benefits by the respondents. Reduce threat of litigation, lower disability/health insurance cost and lower capital cost were received the lower ranks and RII value of each factor was less than 50. Period of achievement of economical benefits were analysed using Mode. Figure 2 depicts the results of professionals' perception on period of achievement of economical benefits. It is evident that the most of the economical benefits are long term benefits, where they are achievable two years after construction of the building.

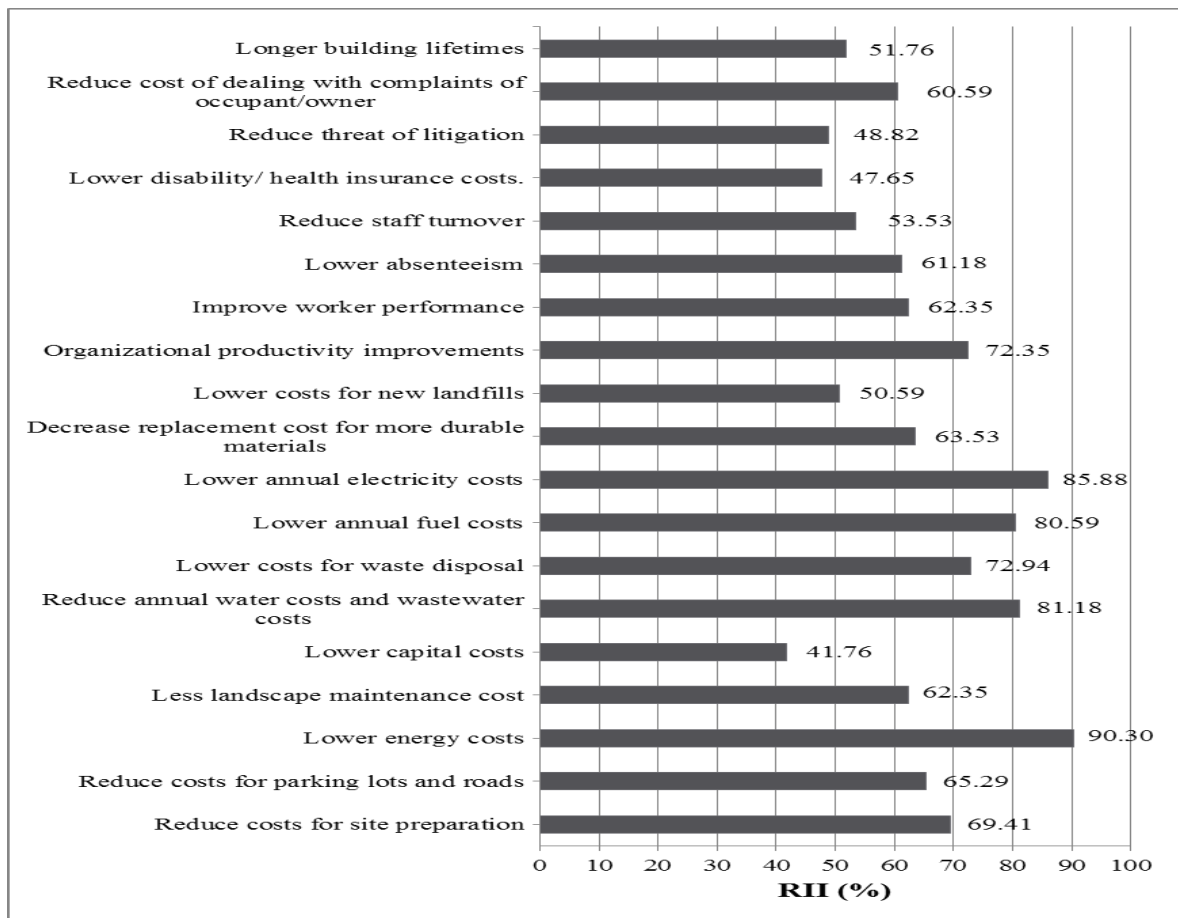


Figure 1: Level of economical benefits

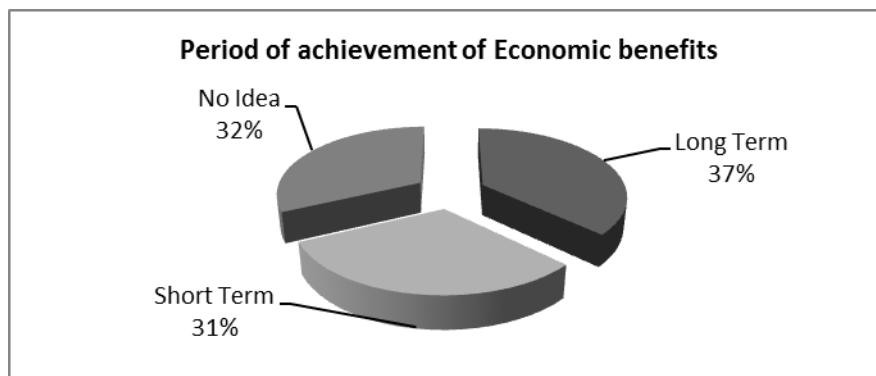


Figure 2: Professionals' perception on period of achievement of economic benefits

## 4.2 Analysis on social benefits

Level of social benefits were analysed using RII and results were given in Figure 3. It is evident that 'Preservation of water resources for future generations' (RII- 86.47%) is the most beneficial social component in adopting green concept for construction of buildings in Sri Lanka identified by the respondents. Subsequently, expand market for environmentally preferable products, reduce adverse health impacts, improve occupants' satisfaction and comfort and increase transportation options for employees were ranked as the next top four factors under social benefits. The least social benefit factor was fewer waste water treatment plants (RII- 50%).

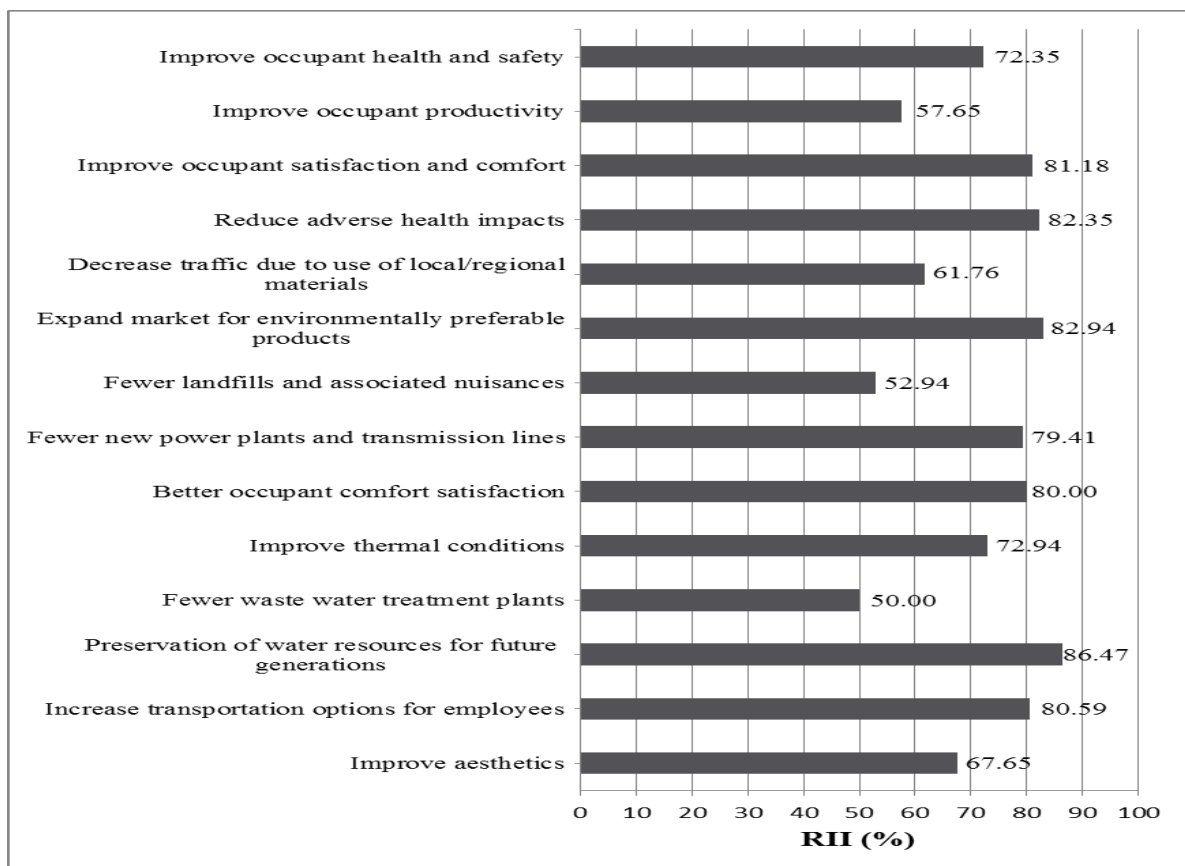


Figure 3: level of social benefits

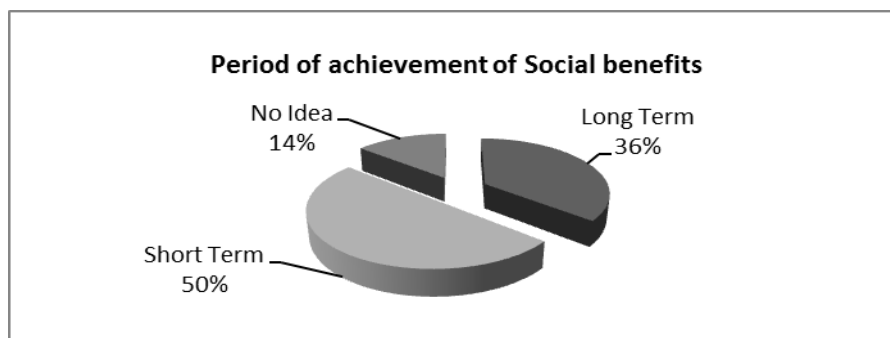


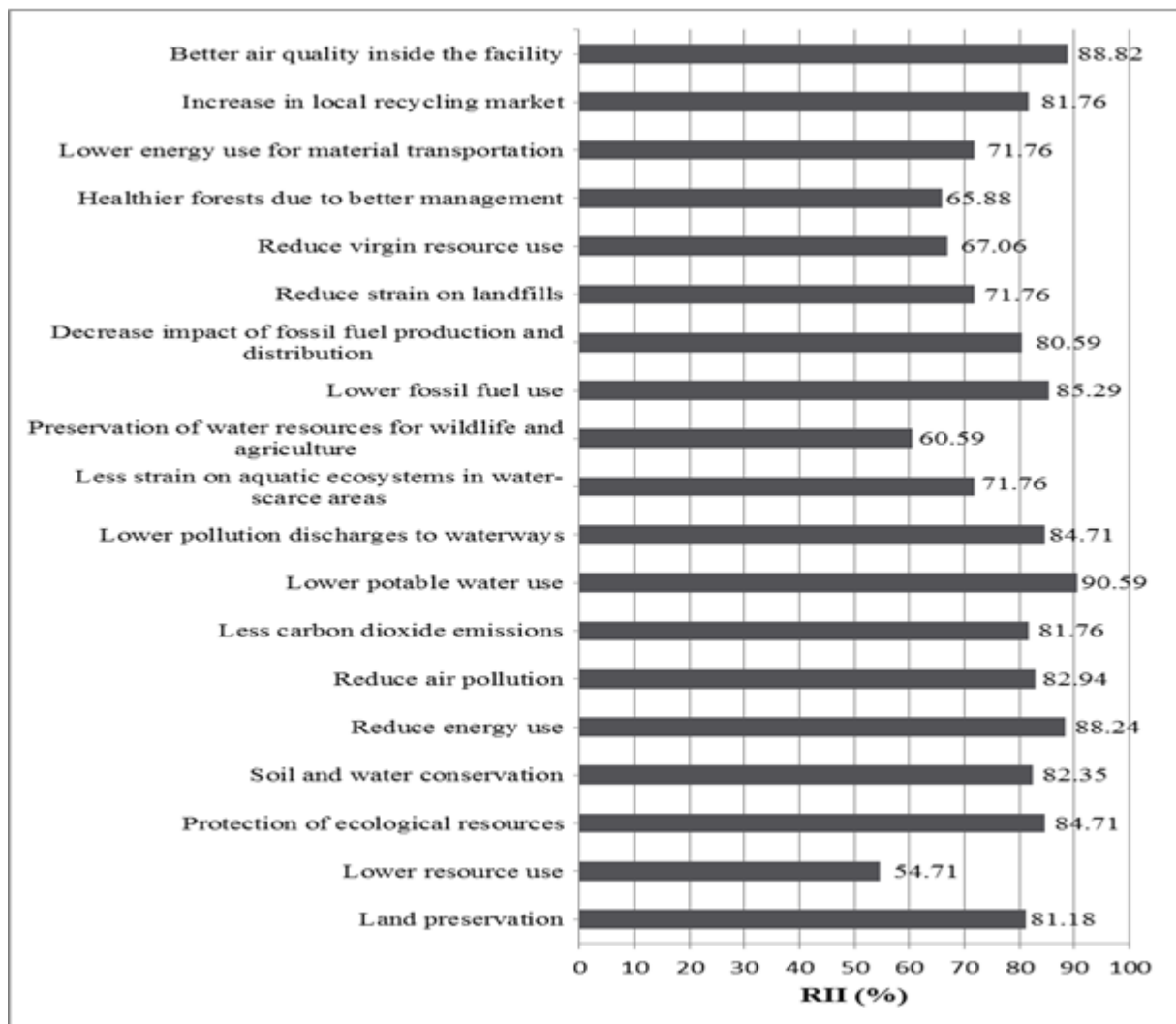
Figure 4: Professionals' perception on period of achievement of social benefits



Figure 4 shows that many social benefits are short term which represents 50% of whole social benefits. In other words, this is equal to the half of the social benefits and also 36 % benefits were identified as long-term achievements by the respondents.

### 4.3 Analysis on Environmental benefits

Level of environmental benefits were analysed using RII and results were given in Figure 5. Respondents identified that ‘lower potable water use’ (RII- 90.59%) is the most beneficial environmental component in adopting green concept for construction of buildings in Sri Lanka.



*Figure 5: level of environmental benefits*

Better air quality inside the facility, reduce energy use, lower fossil fuel use and protection of ecological resources were identified as the next top four environmental beneficial factors out of the nineteen. Based on the professionals’ perception, ‘Lower resource use’ (RII- 54.71%) is the least beneficial environmental component in adopting green concept. Period of achievement of

environmental benefits were analysed in Figure 6. According to Figure 6, long-term and short-term benefits represent 58% and 32% respectively. However, 10% doesn't have an idea about the period of achievement of environmental benefits when construction of green buildings in Sri Lankan context.

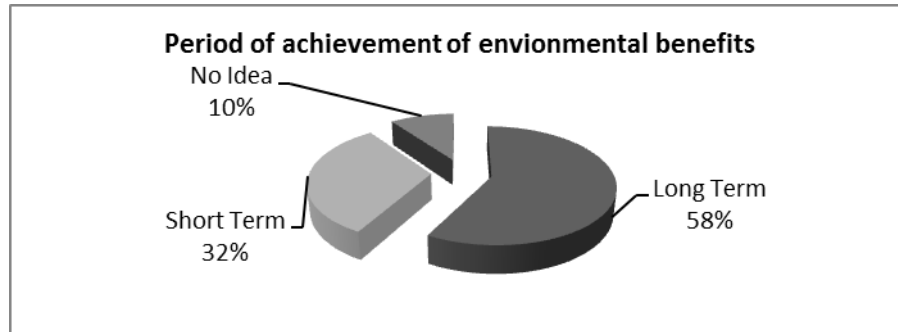


Figure 6: Professionals' perception on period of achievement of environmental benefits

#### 4.4 Comparison of economic, social and environmental benefits

Altogether there are fifty two benefits were identified by the adoption of green concept for construction of buildings through literature review and these benefits were categorized into economic, social and environmental areas. According to the analysed data, total percentages of the period of achievement of benefits in each area can be summarised as shown in Table 3. With respect to the professionals' view, it is depicted that, many benefits belong to long-term which is more than two years and also considerable number of short-term benefits were identified. Respondents did not have an idea about the period of achievement of many economic benefits compare to social and environmental benefits which are recognised through the literature. Reason behind the answer 'no idea' may be due to less experience about implementation of green concept still in Sri Lanka.

Table 3: Summary of period of achievement of benefits in each area

Professionals' perception on period of achievement	Area		
	Economical	Social	Environmental
No idea	32%	14%	10%
Short term	31%	50%	32%
Long term	37%	36%	58%

Table 4 summarises all the benefits for which the RII value is greater than 80% and indicated the period of achievement of each benefit whether long-term, short-term or no- idea. When considering the total number of environmental benefits, 63% of the benefits have exceeded the margin of 80% of RII value in the level of benefit. In social benefits, 43% of benefits have exceeded 80% RII value in the level of benefit.

Even though, there are nineteen economic benefits identified, only four benefits among them were ranked more than 80% RII value which was almost equal to 21% from the total. This is quite low compared to the environmental and social benefits. According to Table 4, even RII value is greater

than 80%, there is no idea about the period of achievement about ‘soil and conservation’ and ‘land preservation’ under the environmental category. It is important to note that ‘preservation of water resources for future generation’, ‘lower potable water resources’ and ‘lower energy costs’ were ranked as the top benefits in social , environmental and economic areas respectively. Efficiency and conservation of water is one of the key fundamental features in the green building concept. Moreover, the results support to highlight the significance of managing water in a building with the sustainable development.

*Table 4: Benefits which the RII is higher than 80% with their period of achievement*

Area	Benefit	RII (%)	Rank	Period of achievement
Economical	Lower energy costs	90.30	2	Short term
	Lower annual electricity costs	85.88	6	Long term
	Reduce annual water costs and wastewater costs	81.18	16	Long term
	Lower annual fuel costs	80.59	19	Long term
Social	Preservation of water resources for future generations	86.47	5	Long term
	Expand market for environmentally preferable products	82.94	10	Long term
	Reduce adverse health impacts	82.35	12	Long term
	Improve occupant satisfaction and comfort	81.18	16	Short term
	Increase transportation options for employees	80.59	19	Short term
	Better occupant comfort satisfaction	80.00	22	Short term
Environmental	Lower potable water use	90.59	1	Long term
	Better air quality inside the facility	88.82	3	Short term
	Reduce energy use	88.24	4	Long term
	Lower fossil fuel use	85.29	7	Long term
	Protection of ecological resources	84.71	8	Short term
	Lower pollution discharges to waterways	84.71	8	Long term
	Reduce air pollution	82.94	10	short term
	Soil and water conservation	82.35	12	No idea
	Less carbon dioxide emissions	81.76	14	Short term
	Increase in local recycling market	81.76	14	Long term
	Land preservation	81.18	16	No idea
	Decrease impact of fossil fuel production and distribution	80.59	19	Long term

## 5. Conclusions

A green building ensures many environmental, economic and social benefits to the owners and users of the built environment. With the exalted growth in the construction industry, there is a great need to encourage the adoption of green concept for construction of buildings in Sri Lanka. Thus, this particular research study focused on identifying benefits of green buildings in the local context. The

study was carried out based on the perceptions of professionals involved in green building projects and a questionnaire survey was carried out to collect data. The results revealed that most of the benefits in each area can be achieved in the Sri Lankan context, but the level of those benefits may differ. As per the professionals' viewpoint, many benefits could be achieved in long-term where it takes more than two years after construction and also considerable number of short-term benefits were recognised by the respondents in all the three areas. Still few buildings have been implemented the green concept in Sri Lanka, many professionals have given the answer 'no idea' about the period of achievement of some benefits identified under economic, social and environmental aspects. Ultimately, the findings of this research will assist the practitioners who involve in the green building projects in Sri Lanka to adopt the most suitable features of the green buildings which lead to the enhancement of economic, social and environmental benefits. Moreover, the study stresses the positive impacts on adopting green concept for construction of buildings.

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